

Faculty Feature

Interview with Dr. Jonathan Tullis

Z: Good afternoon and welcome to the inaugural year of the College Lecture series. My name is Z Nicolazzo and I'm the interim associate dean of Faculty affairs here in the College of Education at the University of Arizona. Before we move into the main portion of today's conversation with Doctor Lawson, I want to start by recognizing that we're recording this session on the lands of the Tohono O'odham Nation, which are the homelands of the O'odham and Yaqui peoples. As a college, the College of Education continues to recognize and honor the native people, lands, waterways, and more than human relations with whom we live in what we now know as Tucson, Arizona. I also want to name that the University of Arizona continues to profit from land grabs of native land in Arizona and across the United States. For more information on this, I would encourage folks to Robert Lee and Tristan Ahtone's 2020 article in *High Country Times* titled [Land Grab University](#). Additionally, I'd like to recognize a name that the work that we do as faculty at the University of Arizona is situated in an institution of higher education that was built, was built through and fueled by the labor of enslaved black peoples. Not only that, but as Christina Sharp's work reminds us, we're still living in the wake of chattel slavery, from which, as Diane Brand reminds us, there is no path back to the door of No return. Black students, faculty and staff continue to face anti-Black racism in higher education, and higher education continues to profit from its ongoing investments in the furthering of anti-Black racism. And so, as a result, much of the work that we do across the College of Education focuses on addressing and counteracting the effects of these deleterious forms of structural violence and oppression. Finally, I want to take a moment to thank the people at the University of Arizona who helped make this event possible today. So first, a big thanks must go to Mike Griffith, Jason Aragon, Erica Lmuth and the entire tech team who organizes and produces all the digital content for the college. Thanks also to our dean, Regina Deil-Amen, for supporting this lecture series. And of course, thanks to all the faculty participating in this series, especially Dr. Jonathan Tullis, which is being featured today. And speaking of doctor, tell us. We'll now move to introductions and the main portion of today's lecture. As I mentioned, at the top of today's session will be featuring the work of Doctor Jonathan Tullis. Dr. Jonathan Tullis is an associate professor in the Department of Educational Psychology. He earned his Ph.D. in

cognitive psychology from the University of Illinois at Urbana-Champaign, did a postdoctoral research fellowship at Indiana University, and then started at the University of Arizona 11 years ago. Dr. Tullis, thanks so much for participating in this lecture series and welcome.

JONATHAN: Yeah, thanks so much. I'm delighted to be here.

Z: Yeah, yeah. Glad to be able to to do this and hear more about your work. So to start us off, can you can you talk me through kind of a broad view of your work? So specifically, I'm wondering what interventions your work makes in the field of education and, if it makes sense for you to extend that scope, the broader communities to whom you're committed.

JONATHAN: Sure. Of course. So, yeah, my research largely focuses on understanding the cognitive and metacognitive processes that underlie durable learning. So we try to answer questions like, why do students remember some things and forget others? Why can they apply knowledge in one context but fail to use it in another? How do we exercise control over our learning and why do we do so? And then just more generally, broadly, what are our innate cognitive strengths? And what are our any kind of weaknesses? And then how do we use those strengths to inform our education? And how do we compensate for those weaknesses? So we try to balance, theoretical research with more applied investigations so we can build a program of research that both refines our theoretical models of memory and metacognition and self-regulated learning, while also providing, empirically based recommendations to practitioners, to teachers, to instructors about how to structure their classes to, benefit students. Retention and application of knowledge. In terms of the community I'm committed to with this work. I was a high school physics and chemistry teacher. It seems like a long time ago now, but, since that time, I've always been committed to, Stem education in particular. And so, at the university here, we work with, faculty across STEM domains, with some interventions in their, in their own courses. And then we also reach out to, local K through 12 teachers and build some collaborations there. Ultimately, we do want to make our scientific insights, about memory and learning and cognition. We want to make those available to, practitioners. And so to that end, we do, have regularly hosted science of learning conferences for our local K through 12 teachers and university faculty here.

Z: You know, one of the things I like about this series is that I get to learn more about the faculty in our college. I had no idea that you were, a chemistry and physics teacher.

JONATHAN: Yeah, a long time ago, but, yeah, it was, it was a challenging time of my career, for sure.

Z: Yeah. I'm just thinking about the very different. I'm a philosophy undergrad, so I'm thinking about the very different knowledge bases that we work with. Right. So you know, it's really helpful to get a sense of the big picture of your work. I know too, that you're the director of the Cognition and Metacognition and Education Lab. So I'm curious, what are the focal areas for this lab, and what are some of the large takeaways from the current work that you've been leading

JONATHAN: So I'll talk about the three main focus areas of our ongoing work. One of them is, about basic memory work and basic memory and cognitive processes, which we had. And then as a career word to investigate. And that was about how we can connect across related episodes to create generalizations across those episodes. Right? So rather than just encoding individual ideas or facts or examples in order to, thrive and create broader concepts that are applicable beyond that, we have to, we have to connect to those episodes, we have to connect to related pieces of information. And so we really examined what causes us to notice and build those connections. And then whether the consequences of building those connections for learning and generalization. And one big idea here is just that, creating these connections across ideas requires effort and attention, right? This does not have been spontaneously or effortlessly. It's not something that is just going to happen with learners, on their own, that learners need to be trained to do this. And we need to be encouraging learners and supporting learners to do this. A second main focal area is understanding the effectiveness of different learning strategies. So when we interact with learning material, we can process it are encoded in many different ways. And so understanding the benefits and limitations of these different strategies is really what we're trying to do. One of the main areas or strategies is retrieval practice. Retrieval practice is just after you've, read something or learned something in order to practice it. To be able to

remember better in the future, it's better to retrieve it from long term memory rather than just re-expose yourself to it. So that retrieval practice is really one of the most beneficial ways of supporting our memory and application of that knowledge in new settings. And so we compare that to other kinds of study strategies. And I think we'll talk about this a little bit later, but we're currently working on using generative AI to support, this type of learning strategy and some of these sort of main takeaways here is that, again, there's productive struggle that's involved here. Right? Struggle or effort that's really useful important to learning if we want to have that durable learning. Not everything is going to be really easy upfront right. So some of these effective strategies require more effort, more attention. And so it's going to feel more this fluent. It's going to feel like we haven't learned. But those difficulties are actually desirable in a lot of these cases. And the third focal area, that we cover or touch on is, learners metacognition, which is just, what learners believe about their own learning, their own judgments of their learning, and then the choices that they make during their study. And so we focus on how do, learners estimate what they've learned and what they haven't learned, because those estimations are crucial to what they choose to do and how they choose to do it. And so we've had students that have examined, sort of the importance of setting goals when interacting with materials. So we had one that Ang Li actually just finished a dissertation looking at the importance of setting goals when regulating your learning through, complex science in relation of climate change, and things like that. Yeah. So those are, sort of broad areas that we're currently investigating.

Z: As a recovering perfectionist who's trying to learn a new language, I'm glad to hear that difficulties through the learning process are actually helpful in terms of how learning is encoded.

JONATHAN: Yeah, there's definitely some really. Yeah, it's definitely desirable to have some types of effort and difficulty. If things are too easy, it often means we're not processing them deeply or making appropriate connections or building the elaborated mental representations that really underline good and effective learning.

Z: Yeah, also makes me think, too, about, yeah, how we share that information with students as they're struggling with learning to. Right. So there are a lot of different applications for these sorts of things.

JONATHAN: Yeah. And they it's really important that they understand that struggles can be productive. Right. They can't just we can't just give them the struggles and have them struggle, but they need to be able to interpret that struggle as something useful. And productive. Otherwise it's going to be they're going to be too burdened and overwhelmed. So yeah there's, there's a balance here between productive struggle and years and, and students confidence and ability to thrive.

Z: I love it. I love it. So, I was reading a piece that you coauthored with Brennan Feder in 2022, where you explored the connection between one's own knowledge and its influence on estimating other's knowledge. Of course, this is particularly significant for teachers who need to be able to determine what students may or may not know and how hard topics may be to learn. So in the piece you write about this expertise bias, or what is referred to as the curse of knowledge. Which I think is such an interesting way to phrase that. Can you explain this phenomenon and what it means for how we can work with teachers to maximize student learning, growth and development in the classroom?

JONATHAN: Yeah. So I really I really love this line of research. I think it's really interesting that we're taking what we know about how we estimate what we have learned and how well we have learned it, and applying it to social context where we need to figure out what other people know and what other people have learned. And so how do we judge or predict what other people know, which, as you are saying, is really critically important for teachers, teachers that can anticipate student knowledge and student misconceptions are better teachers. They they produce more learning, and they're students and teachers who aren't able to anticipate student knowledge and misconceptions. And they can connect to your student's prior knowledge better if they can anticipate students' prior knowledge. And that's a really important part for supporting new learning is being able to connect it and build it off of prior knowledge. But this type of perspective taking, where we try to anticipate what other people know is really

challenging, right? We often think that other people are more similar to us than they actually are, and we often think they believe more similar things to us than they actually do, that their preferences are more similar to our preferences than they actually are. And particularly for this research, that they know the same things that we know. And that's the curse of knowledge. If we know something, we think other people know that information as well. So our judgments about what others know are biased towards our own knowledge. In other words, an expert in the field is cursed by their knowledge that they can't accurately predict what a novice might know. And so I'm sure we've all been in a class where a speaker, a speaker, or a lecturer, doesn't do this well, doesn't take perspective of their audience very well, and their audience gets lost very early on. And, they don't gain much from the lecture because, the speaker has anticipated too much knowledge from the audience. So we became interested in understanding why this bias, arises and how we can overcome it. And we are settling on an explanation that, it's not that our own knowledge actually gets in the way of, our predictions about what other people know. So it's not that this sort of blocks our ability to do that, but it's more about us lacking the cues about what other people know and believe. And so that points us in the direction that, in order to, effectively estimate what our students might know, it's more about getting to know the students. It's more about, yeah, really developing those relationships and using a lot of formative assessments to make sure that they are, picking up what we're putting down, that we're reflecting on of these formative assessments, that we're adapting our instruction based on those, because these are the cues that are going to tell us, more explicitly, yeah. What students can and can't do.

Z: Yeah, I love that. I, I as I was reading your piece, I kept on thinking about, you know, advising student dissertations or thinking about teaching topics multiple times, which I think for faculty it sometimes feels like, oh well, we know this stuff so we can move through it quickly. But it's helpful to think about slowing down and doing some of those formative assessments and evaluations for sure.

JONATHAN: Yeah, it's I've been, even thinking about me advising students and estimating how long it's going to take them to accomplish something. It's like how long does it take me to accomplish? It is not the same as how long it's going to take the student to accomplish it, who's

a novice who's just developing those skills? And so yeah, it's important to really check in, and try to understand their perspective and experience through. Yeah, building those relationships and more sort of open communication at that level. Yeah.

Z: So this past spring, you were named as a 2025 Distinguished fellow for the center for University Education Scholarship, or CUES, to my knowledge, you're actually the very first person for the College of Education to be awarded as a CUES distinguished Fellow. So big congrats for that accomplishment. First and foremost. Can you tell us a little bit about your fellowship project and and what you hope can come from it?

JONATHAN: Yeah. Thanks so much. Yeah. Our project is titled Harnessing Generative Artificial Intelligence to Benefit Student Learning. And a big shout out to my graduate student, Hosain Heshmati, who is really the impetus behind this whole direction of research. His saw a need to understand the impact of generative, artificial intelligence on learning and sort of push us in that direction. So, yeah, generative artificial intelligence is such a transformational technology that's just really quickly shifted. How students approach their learning, right? Something like 95% of students now admit to using generative AI in their classes on a weekly basis in a wide variety of different ways. And it's true that this, can make things a lot more efficient. But with these new tools, there's a ton of confusion about how we should be using them, when we should be using them, and a lot of questions about how to use them responsibly. So yeah, teachers, instructors, researchers we still really don't have clear ideas about how to use them to support student learning and not to replace it. And students really also have no good guidelines or recommendations about how to use it to support their own learning. So in this project, yeah, we're starting to examine, how we can do that, how we can use, generative AI like ChatGPT or Gemini or Claude to see, how that generative AI is going to impact student learning and how we can harness its capabilities to support student learning. Right. So there are some clear affordances of this generative AI technology that could be really useful. So it can do things like generate an unlimited number of questions related to a topic. It can provide immediate feedback related to students answers. It can tailor and adapt instruction and feedback and questions to a student's level. So lots of good affordances, but we don't really know how effective it is or in what ways we can use it. We're really taking some early forays into this area.

To see if it can support durable student learning and if we can offload some of the normal study effort on to this to make it easier and more efficient for our students. And some of our earlier work is showing really surprising results that I would not have predicted. Like students who write summaries of readings don't seem to learn as much as students who read ChatGPT these summaries of our reading, and evaluate them. And having ChatGPT do it is a lot more efficient. So those are very early, preliminary results for us, trying to understand why or how that works. So the CUSE project, we're working through a series of five different experiments to test whether generative AI can create retrieval practice opportunities or basically practice tests for students to help students retrieve information from long term memory and to provide them with that feedback, that these retrieval practice opportunities are so, impactful for long term learning. So we're doing this across, both Ed psych students and, some chemistry students with different versions of, you know, ChatGPT asking students questions. And we compare that to how well students could learn this on their own. We can have ChatGPT adapt to those levels of questions, to learners and to learn performance. And we can also have ChatGPT just answer practice questions for students, rather than having students answer it themselves with the idea that we are trying to find where it's useful and when it's limited, and when it replaces student learning rather than supporting student learning. But yeah, the ultimate goal is to, to create some principles we can use to build, some chat bots that we could then, run in some actual classes as, like an online presence tutor, for students, to help them learn and study on their own. Right. There's work showing that students are more likely to interact with these chat bots than to go to office hours, because they're not ashamed to admit they don't know things for these, chat bots and, and other things. So, yeah, it's a really interesting project. I'm excited to see what we find.

Z: Yeah. That's actually yeah. Super exciting. All the different areas that that could go, you know, I've been in more conversations than I can count with people who are talking about AI and its applications to education. I think, too, that there are several people that I have talked to who, have reminded me about some of the fervor and concern when things like Wikipedia started. And all of these concerns about to use your language with this, replace learning and writing, or would it become a component that people could use to, enhance their learning right, as you're talking about this idea of durable learning? So it's interesting to think about how we

can leverage AI to be a component of, or kind of a sidecar to student learning in a sense. As well as I think some of the attendant ethical questions that you're, that you're raising to.

JONATHAN: For sure. Yeah. I mean, I think we don't understand the, the boundary conditions here of when it's going to be useful and when it's actually going to do the students work for them. I mean, as we were talking about earlier, often putting in effort and often struggling can be really useful. So understanding when that productive struggle is actually productive and when we can do some of that struggle with the assistance of ChatGPT to alleviate some of those, burdens. Those are still unanswered question that I think a really interesting.

Z: Yeah, yeah, yeah. And in some senses it seems like ChatGPT and other generative AI tools become part of a study group, which is something that's been a long practice in education. Right?

JONATHAN: It's just a different a different person or tool to interact with.

Z: Yeah. What you know what, what interests you about AI in education. What are some of the things that brought you to this study and what are some things that you might encourage the rest of your fellow educators to be thinking about when it comes to AI?

JONATHAN: Yeah. Yeah. So I mean, yeah, I do want to acknowledge that there are some bigger, broader concerns about using AI. So many concerns persist about how to use it responsibly and in terms of how much energy and water it consumes, how it uses and stores our data. Who owns these companies, right. And even in practical terms about its accuracy. So there's still a lot of these concerns that we do need to make progress, around in terms of responsible and equitable solutions. But it's just undeniable that, AI and large language models have opened up a ton of new opportunities and just have changed how students interact with their course materials. So it's more about addressing the reality of our current context and trying to understand, that reality. And then use that reality to support student learning. Yeah. Just more generally, I think what interests me about this is that while I do love thinking about how the brain works in theory, like on its own, how it processes, encodes stories and retrieves

information, we do live in contexts, right? We do live, we do live in context. We learn in context. We have to apply our learning in context. And this can be everything from our physical environments, our political era that we're navigating, the social connections and relationships that we make, but also the technologies that are present, right. The technologies that are present while we are learning. And these socio-cultural technologies have always radically changed and shaped how we learn and interact from, like human language to the printing press to the internet, to Wikipedia, as you were mentioning. Right? These kinds of technologies don't exist, sort of separately from how we think and learn and operate. But they're really shaping and a part of, how our brain works now. They're really a part of our mind. They're an extension now of how our cognition works. So it's really interesting to think of that interaction of our cognition with technology for understanding real world learning. Right. It's also really interesting because generative AI is used across so many different domains. I like you're saying you have so many conversations. Just in the last week, I've had conversations with a physiologist who uses it in their classes to talk about how proteins fold right. And I've with a marketing professor who uses it with their students to help write business plans and, worked with your nose and throat surgeons to, to write up a grant about training surgery techniques using AI. Right. So this it's just like a very broad, technology that that's impacting so many different domains. In terms of my views for, instructors in these current contexts, I think I'm thinking of this as, analogous to the invention of, an internal combustion engine and how that sort of revolutionized or changed how we interact in the world, how we get around. And it changed, the skills and the jobs that we needed. Right. So after cars and internal combustion were around, we no longer had to wash and feed horses and take care of animals. But we did have to need new skills. We didn't need to learn how to drive. We needed to learn a little bit about car maintenance. I think the development of generative AI can have similar impacts made by a shift of the skills and the abilities that our students and learners may need in the future. It's going to change how we operate in the world. So, how I've been doing this is really been trying to think about the learning goals and the points of my courses that like, what am I trying to get my students to do? And make sure that they those learning goals are situated in this current and future contexts of the world. So, that may change the skills that we're trying to teach, that may change the knowledge that, we think is required or important for learners away from sort of more static knowledge to more abilities to identify problems, to frame problems, and to evaluate output that

we get from collaborating with, AI and even thinking about the importance of building human relationships as part of courses. Yeah, I think those are all really important things to, to reframe or think about our courses more broadly. then just on a more, or while we are doing that, I think we want to think, about what skills or knowledge that we want to offload to AI completely, in other words, what skills do you want generative AI to automate and just do for us? What skills do we want to collaborate with AI on? In other words, what skills or knowledge can we use with with AI? And then what skills and knowledge do we want to protect? Which ones do we want our learners to retain and keep and not have influenced by AI? And I think that sort of distinction about automate, collaborate and protect is also an okay framework to think about as you are thinking about your learning goals.

Z: I love that it's super helpful to think about or to think about. Yeah. Where there's overlap and there maybe could and should be overlap versus I like this language of what do we protect. And then what do we kind of automate.

JONATHAN: Yeah. Because there's ongoing research showing that like if you use too much AI, it can get in the way of critical thinking and problem solving. Right. And so there could be some skills or instances like critical thinking or evaluating the truth of statements that we want to protect from AI, that we don't want to offload to AI. But there can be like, menial tasks that we really just want to use AI to do that are not important for us to, to do on a, on a day to day basis.

Z: Yeah, yeah, yeah. I really appreciate you talking to about especially with our contexts in the southwest where we have already a shortage of water, it's really helpful to think about the stress on the electrical grid and our water systems when we think about these technologies, as we're also starting to think about what do we offload, what do we protect, how do we partner? And realizing that it's I appreciate your answer, helping me kind of think through the fact that it's, it's not an either/or but a both/and it's not either we use AI all the time or we use it none at the time. But really thinking strategically and thoughtfully, given all of the broader context about how we engage with this.

JONATHAN: These are not easy or simple questions for sure.

Z: Yeah, yeah, yeah. So last question for you. Something I often talk to educators about is imagining what educational practice could look, sound and feel like. By this, I mean, what are the radical possibilities of what education could be beyond the confining, limiting, and often, often damaging ways? Education is currently shaped through policy and practice. So to this end, I'm wondering how would you talk about what your hopes, dreams, and imagined futures are for education based on the work that you're doing?

JONATHAN: Yeah, I love that question. I've been thinking about it a lot lately, even before this conversation. Just particularly in the context of the advent of generative AI and its implications for education. Right. So I think, given its capabilities to summarize information and compile existing information and, and even answer some pretty complex questions, I've really been wrestling with the, the purpose of education. Right. Being really what are we what are we trying to do for our learners with, education? And it brings me back to, of course, I took on the philosophy of education, I think at my freshman seminar in college, one of the very first courses that I ever took, about. Yeah. What what do we want education to be for? And I think, it has to be more than just the learning of facts and knowledge or about being able to learn how to apply knowledge, because those are things that generative AI is, is really good at. So it, it needs to be used for bigger, broader ideas. There's some ideas, right? That education is a tool for developing a skilled and productive workforce. And I think that's a really limiting idea, too, particularly in this context of, AI, which is radically changing or which may radically change, the jobs that are present in the future. There's ideas of education as a tool for developing an informed, citizenry, civic participation. I also think that's a little limiting in terms of what we are trying to do. With education. But on the converse side, I think that education there's other ideas about what education can be good for. Like as a tool to reduce social injustices and reimagine our society. And that can do these through, through different ways, like using education as a tool to enhance the lifelong agency of students to help students feel real freedom to live their life with personal value, to find personal worth, and of a sense of accomplishment. Right. So to see education as a tool for empowering individuals to meet fundamental needs of of feeling confident of, of developing social relationships and connections and, being able to

exercise some level of control or autonomy over their life. I think those are really the bigger, broader ideas of what I would love to see education be focused or shifted towards, to really change, how it's currently structured to focus more on creating ultimately sort of lifelong happy, empowered people.

Z: Come through a philosophy of education class. Look at that.

JONATHAN: Who knew I would be calling back to that 20 years later.

Z: Speaking of lifelong learning and retrieval. Right. Like that's deep learning that you can retrieve.

JONATHAN: That's right.

Z: Thanks so much for your time today, Dr. Tullis. It's been fantastic getting to know you in your work better. And I'm excited to see where your current work leads, especially all this, CUSE data that you're, you're sifting through. Thanks to for all of you who watched this video, I hope you've gained as much insight as I have. If you're interested in learning more, I would encourage you to look up some of Dr. Tullis's scholarship. You can find his work highlighted on the University of Arizona College of Education website, including his entry in our College Faculty Features series, where he shares about his inspirations, accomplishments, and the advice he would give his younger self. Thanks again Dr. Tullis. A pleasure having this time together.

JONATHAN: Yeah, thanks.